Aura Validation by the JPL MkIV Balloon Interferometer

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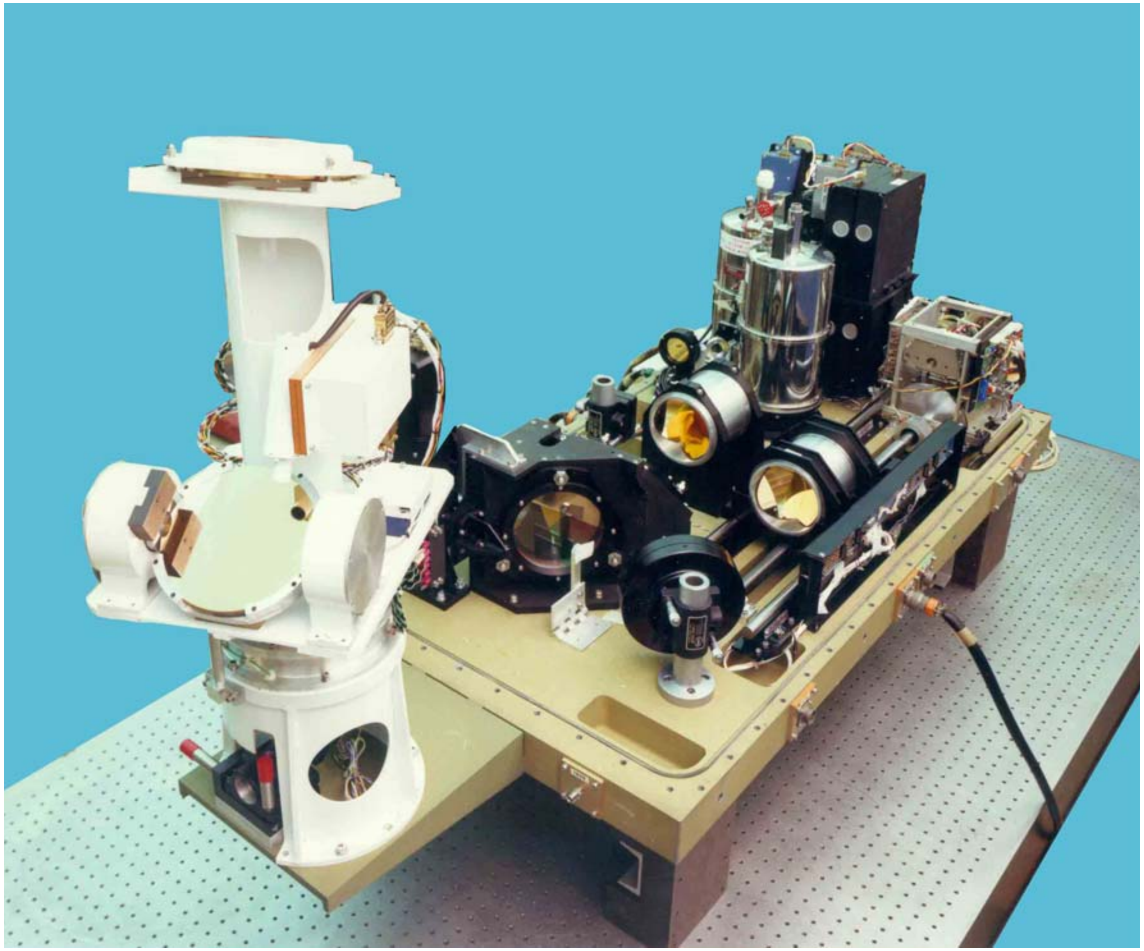
MkIV Interferometer

MkIV was one of 4 JPL instruments (SLS, FIRS2, O3, BOH) that flew from Ft Sumner in Sep 2004 and 2005 for the purpose of Aura validation.

MkIV in a balloon-borne FTIR spectrometer that operates in solar occultation mode.

It measures the 650-5650 cm^{-1} spectral region at 0.01 cm^{-1} resolution. Over this interval many different gases have spectral signatures, including H_2O, CO_2, O_3, N_2O, CO, CH_4, N_2, O_2, NO, NO_2, HNO_3, HNO_4, N_2O_5, ClO, $ClNO_3$, H_2O_2, H_2CO, HCOOH, HOCl, HCl, HF, SF_6, COF_2, CF_4, CH_3Cl, $CHFCl_2$, $CFCl_3$, CF_2Cl_2, CCl_4, OCS, HCN, CH_3CN, C_2H_2, C_2H_6, plus isotopic variants (e.g. HDO).



MLS Comparisons

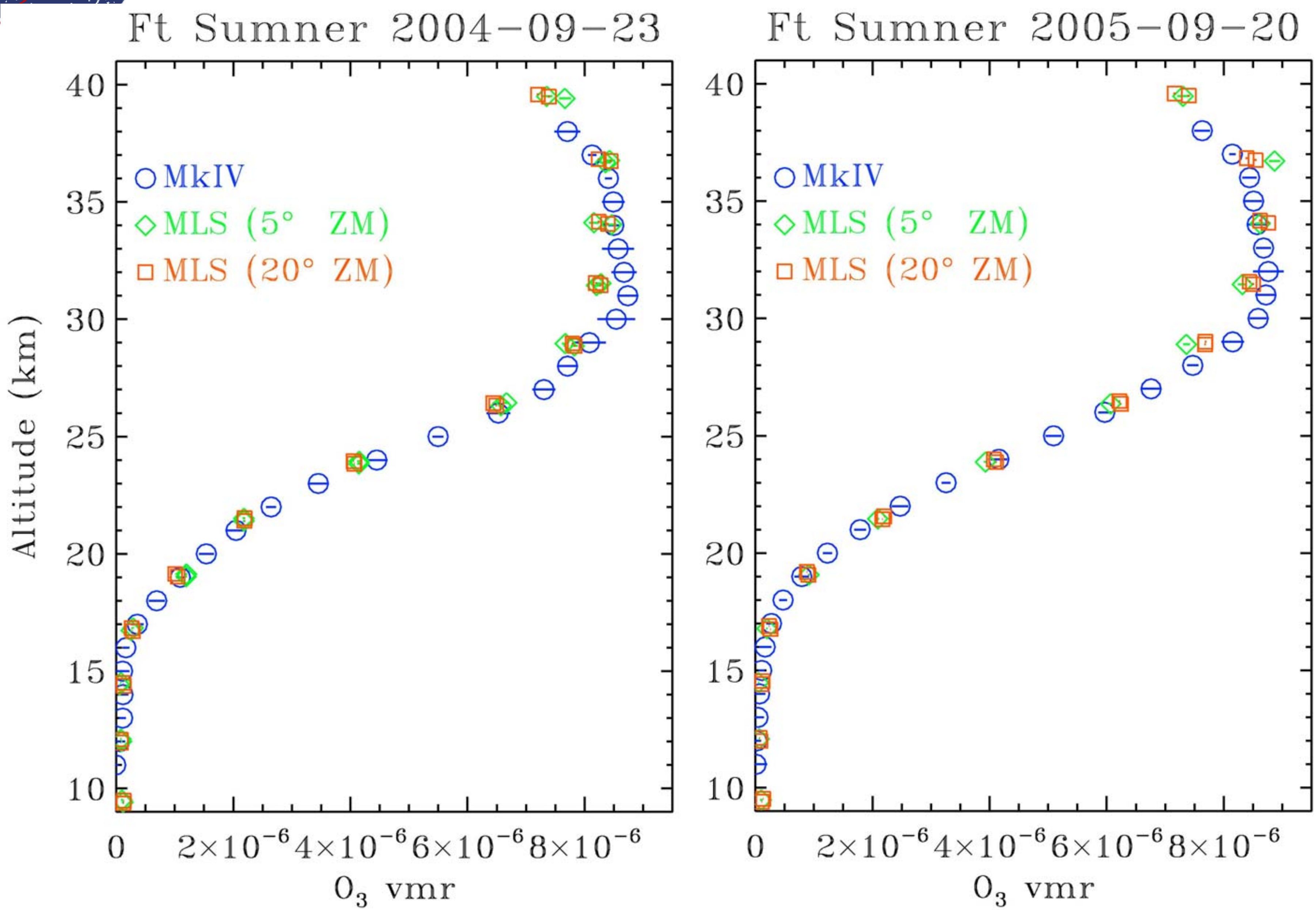
This presentation focuses on MLS validation.

In the next 8 slides, MkIV sunset profiles measured in Sep 2004 and 2005 are compared with MLS V2.1 zonal mean profiles.

For some gases (e.g. O_3, H_2O) that MLS measures with good precision, comparisons of individual profiles might be more appropriate, but other speakers have already shown these.

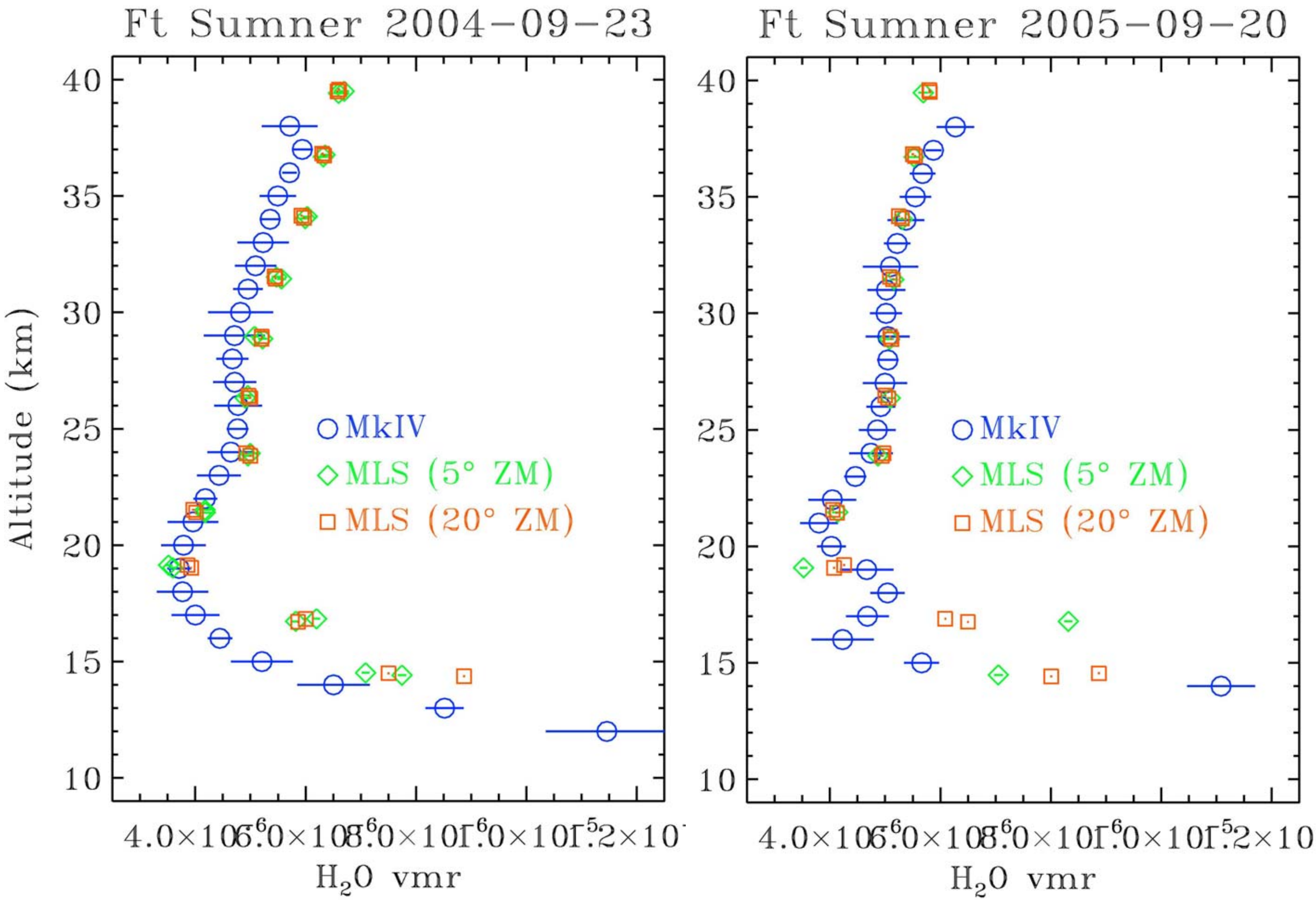
In subsequent plots:
MkIV profiles are denoted by blue circles
MLS 5º ZM are denoted by green diamonds
MLS 20º ZM are denoted by red squares

O_3



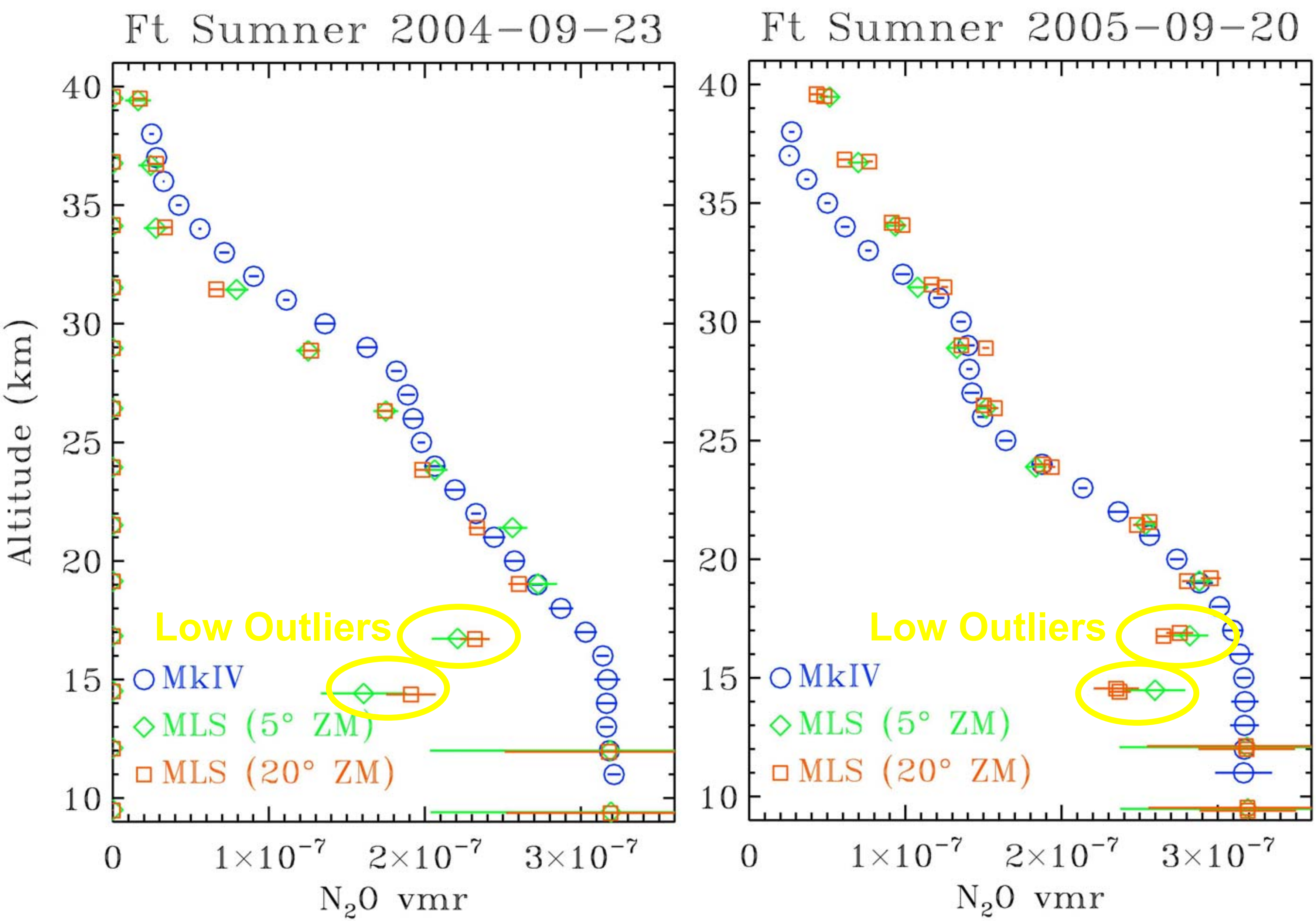
Ft Sumner 2004-09-23
Ft Sumner 2005-09-20
MkIV
MLS (5° ZM)
MLS (20° ZM)
Altitude (km)
40
35
30
25
20
15
10
0
2×10^-6
4×10^-6
6×10^-6
8×10^-6
O3 vmr

H_2O



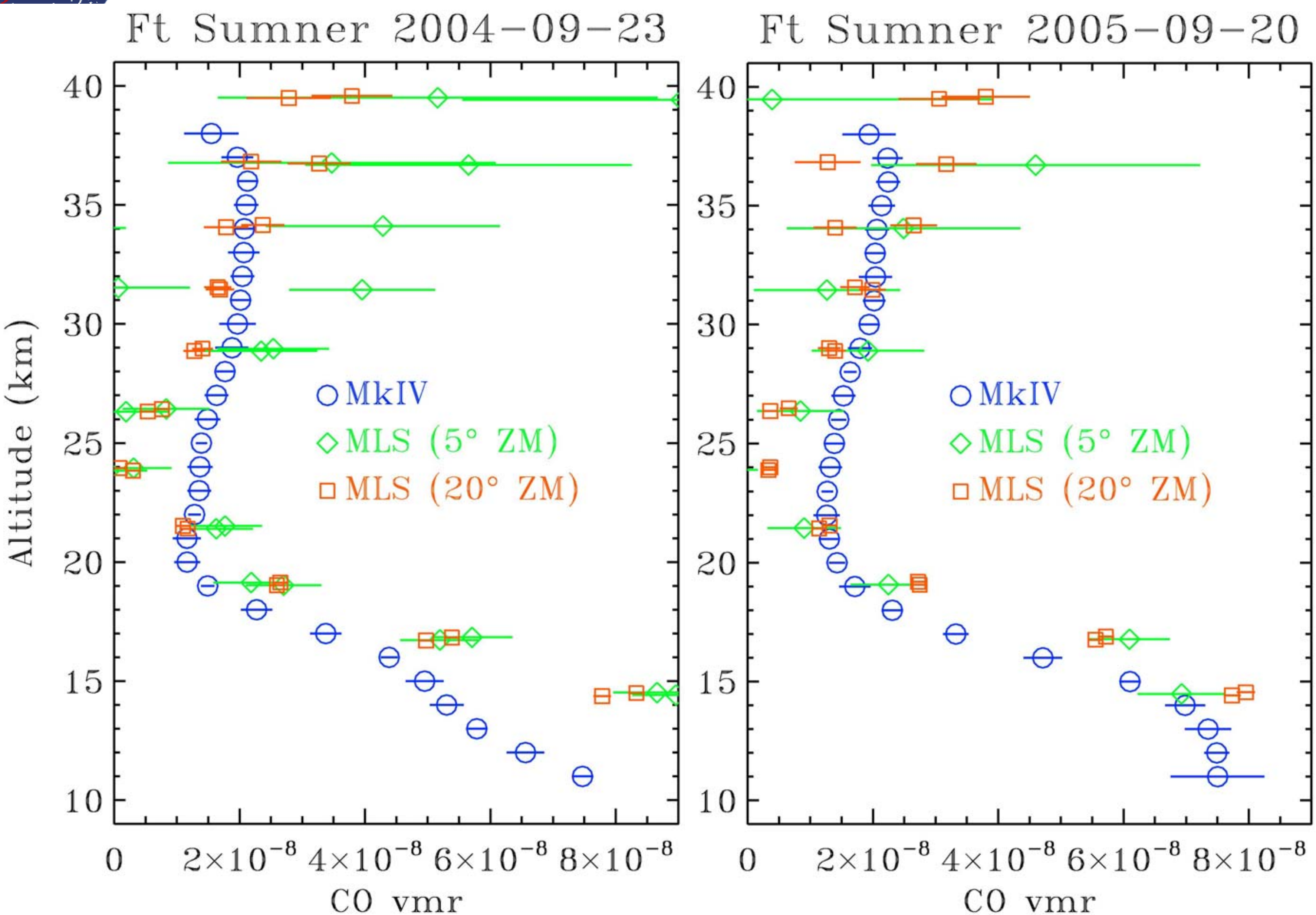
Ft Sumner 2004-09-23
Ft Sumner 2005-09-20
Altitude (km)
40
35
30
25
20
15
10
MkIV
MLS (5° ZM)
MLS (20° ZM)
4.0×106.0×108.0×101.0×101.2×10
H2O vmr

N_2O

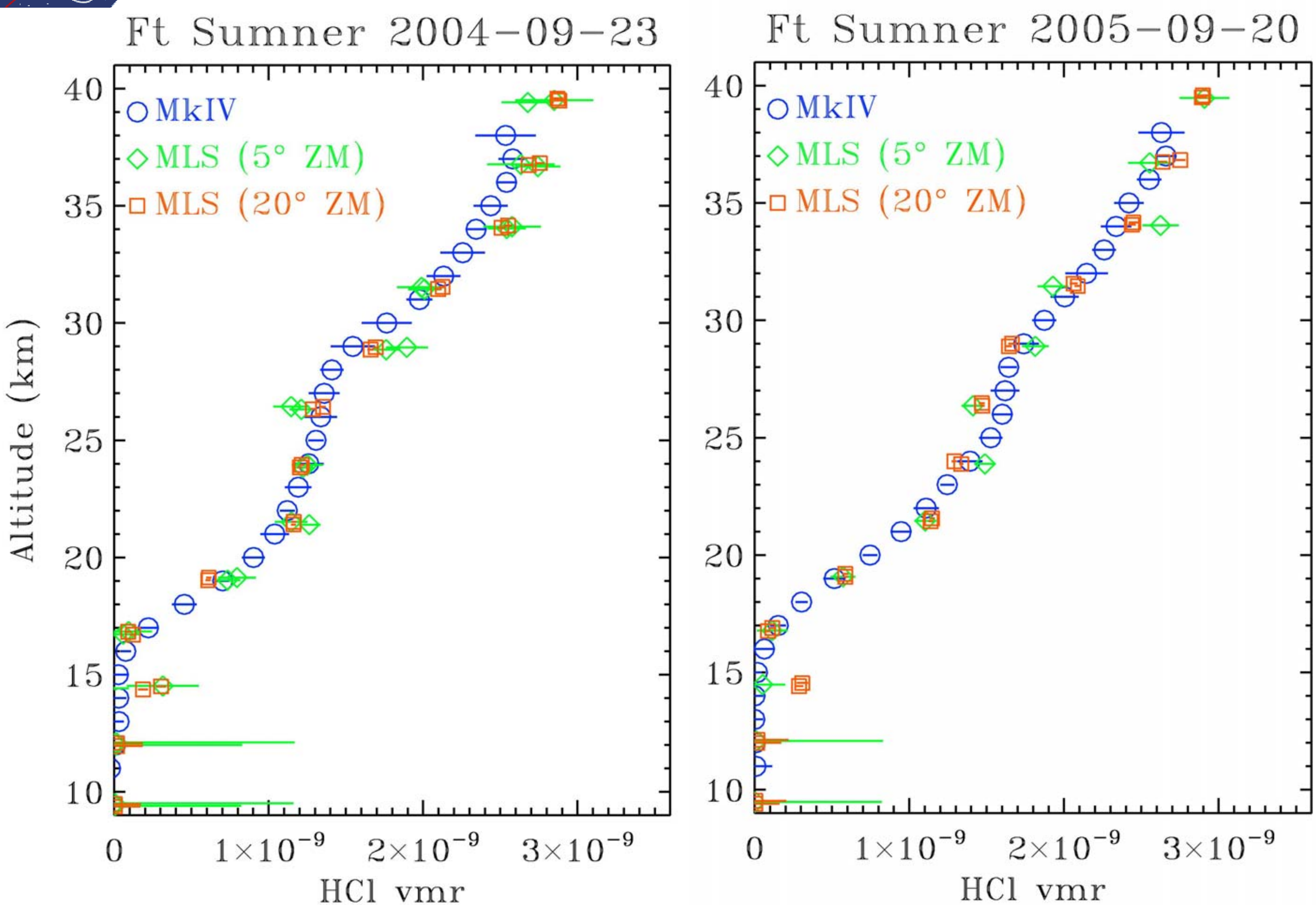


Ft Sumner 2004-09-23
Ft Sumner 2005-09-20
Altitude (km)
N_2O vmr
0
1×10^{-7}
2×10^{-7}
3×10^{-7}
10
15
20
25
30
35
40
Low Outliers
MkIV
MLS (5° ZM)
MLS (20° ZM)

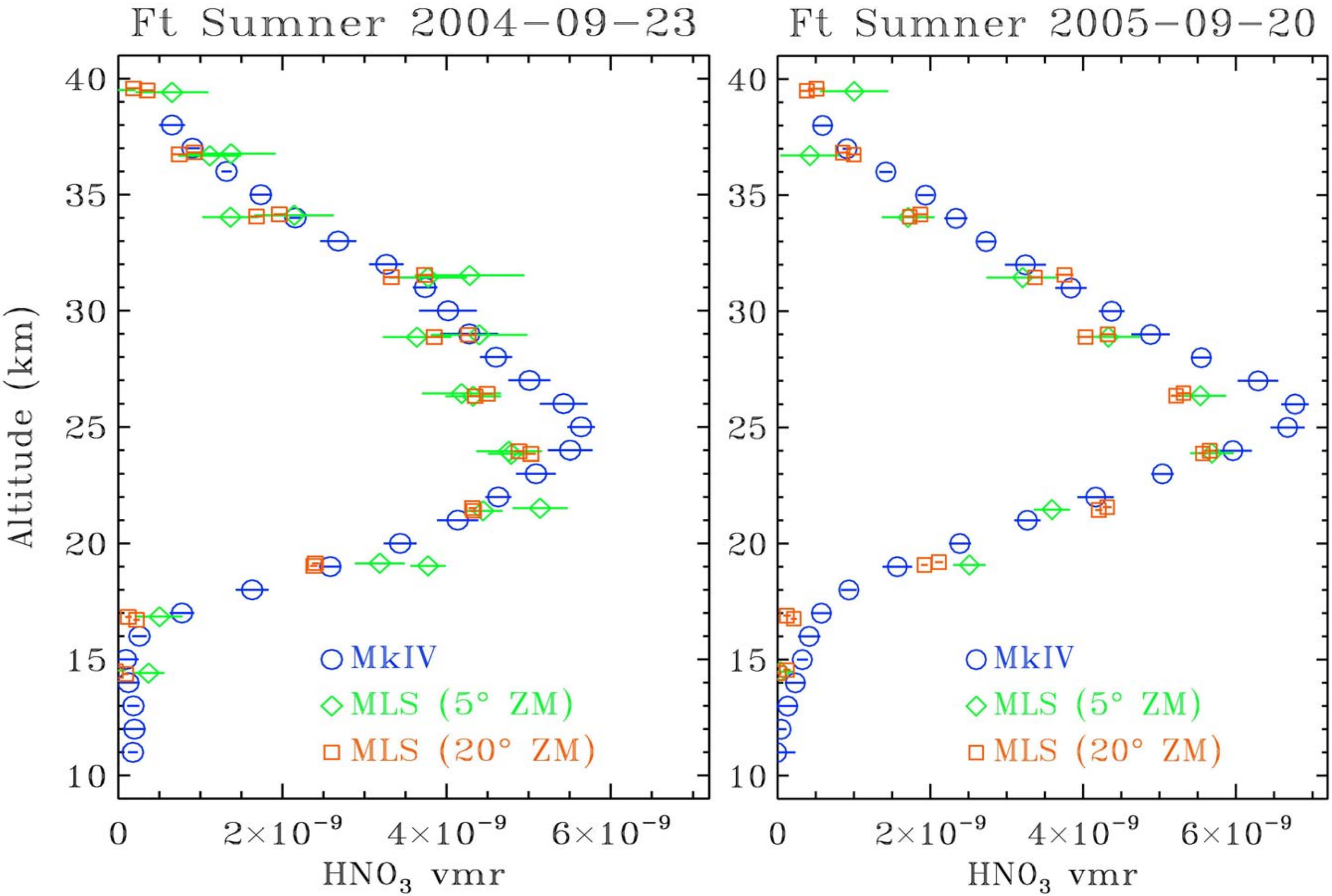
CO


Ft Sumner 2004-09-23
Ft Sumner 2005-09-20
Altitude (km)
CO vmr
MkIV
MLS (5° ZM)
MLS (20° ZM)
40
35
30
25
20
15
10
0
2×10⁻⁸
4×10⁻⁸
6×10⁻⁸
8×10⁻⁸

HCl

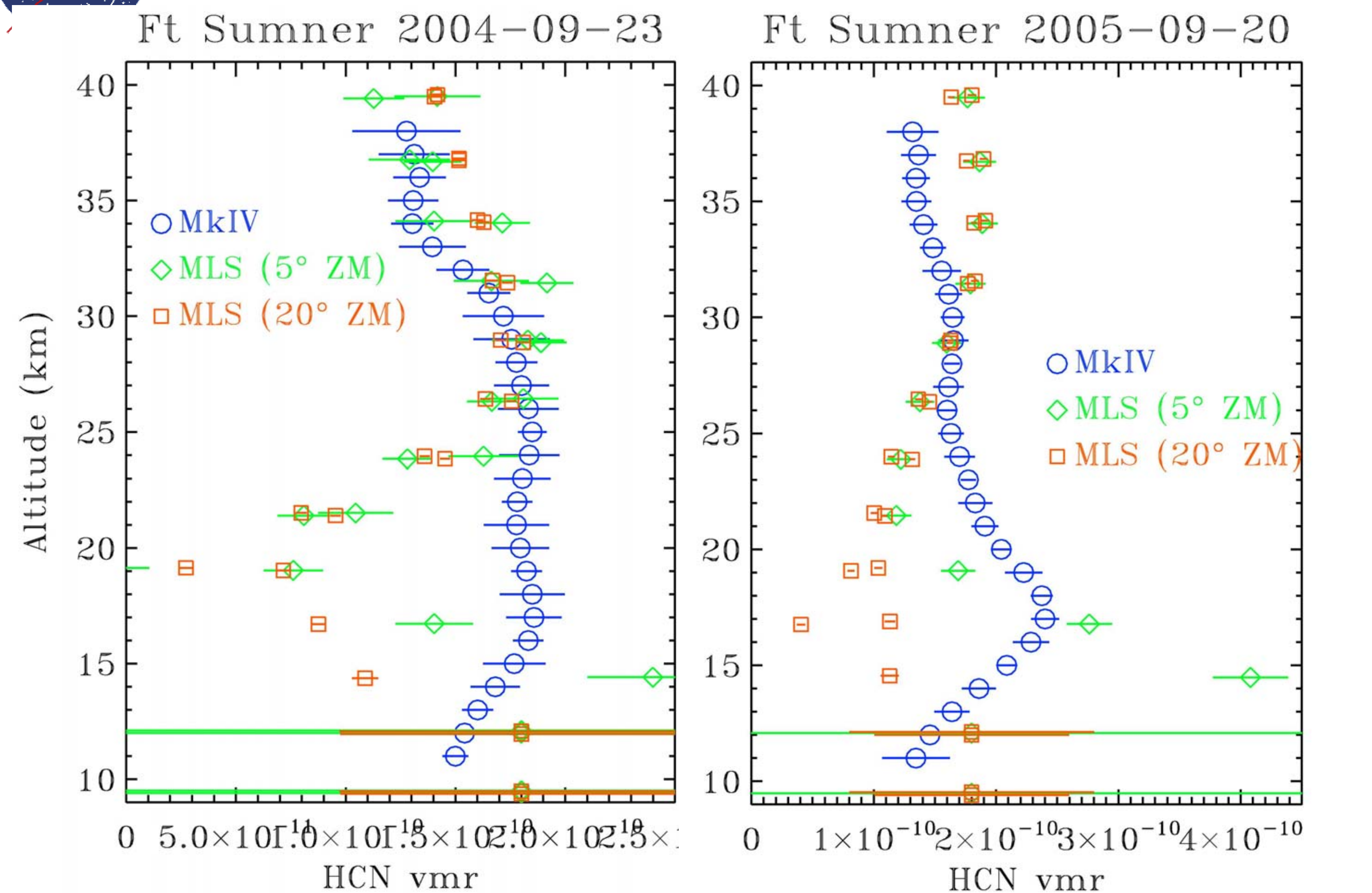

Ft Sumner 2004-09-23
Ft Sumner 2005-09-20
MkIV
MLS (5° ZM)
MLS (20° ZM)
Altitude (km)
40
35
30
25
20
15
10
0
1×10⁻⁹
2×10⁻⁹
3×10⁻⁹
HCl vmr

HNO_3

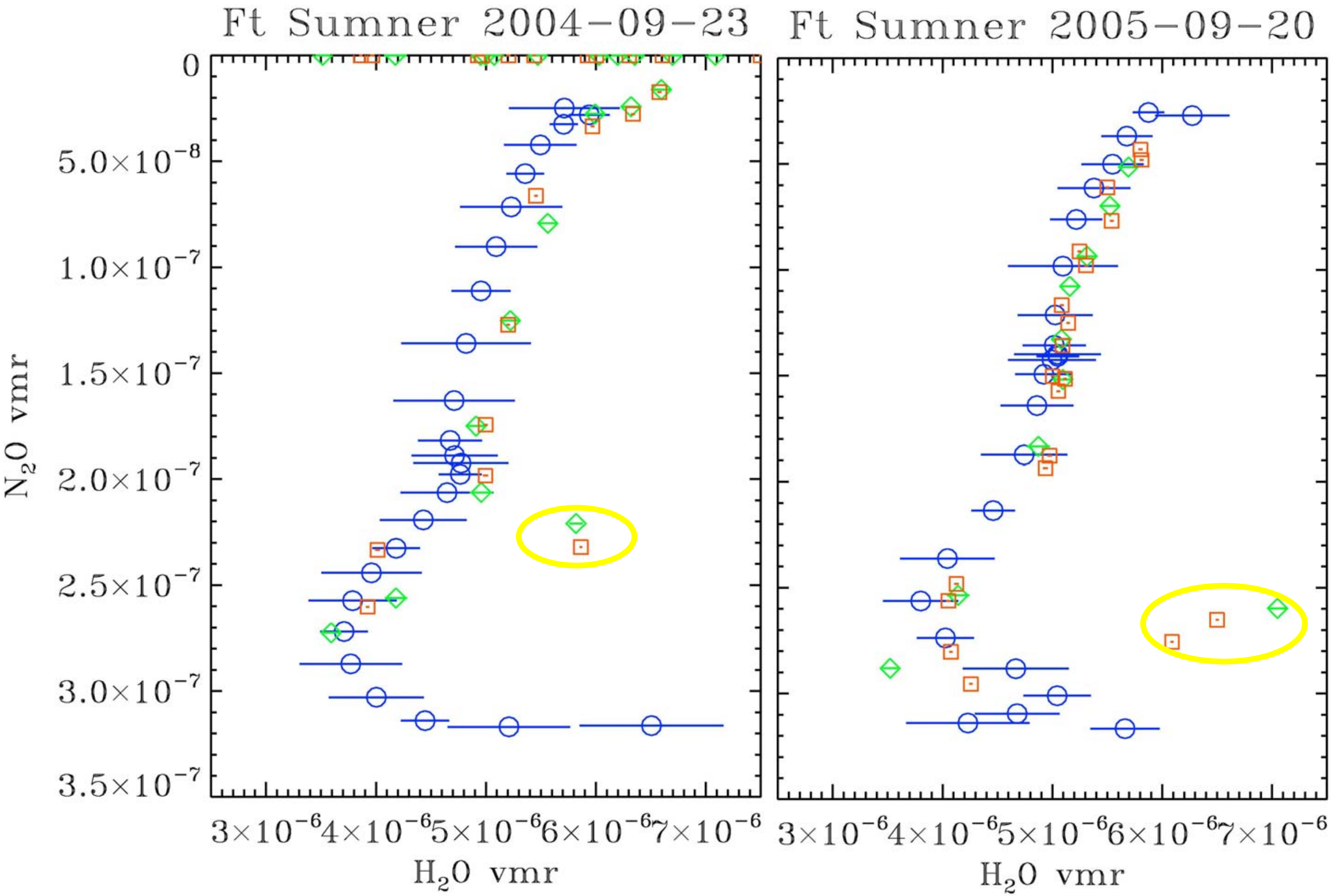


Ft Sumner 2004-09-23
Ft Sumner 2005-09-20
Altitude (km)
40
35
30
25
20
15
10
0
2×10⁻⁹
4×10⁻⁹
6×10⁻⁹
HNO3 vmr
MkIV
MLS (5° ZM)
MLS (20° ZM)

HCN


Ft Sumner 2004-09-23
Ft Sumner 2005-09-20
MkIV
MLS (5° ZM)
MLS (20° ZM)
Altitude (km)
HCN vmr
40
35
30
25
20
15
10
0
5.0×10⁻¹¹
1.0×10⁻¹⁰
1.5×10⁻¹⁰
2.0×10⁻¹⁰
2.5×10⁻¹⁰
1×10⁻¹⁰
2×10⁻¹⁰
3×10⁻¹⁰
4×10⁻¹⁰

H_2O/N_2O Correlation



Summary

Agreement very good for O_3 and HCl, both for 2004 and 2005.

MLS O_3 vmr tends to peak at a higher altitude (35 km) than MkIV (32 km).

Agreement for H_2O excellent in 2005, but in 2004 MLS is 5-10% larger above 28 km (possibly need to look at individual profiles instead of ZM). Plotting H_2O versus N_2O (instead of altitude) reduces discrepancy.

MLS N_2O agrees reasonably well above 20km, but has low outliers at ~15 km for both flights. This outliers are expected to be fixed in MLS V2.2.

MLS CO vmr minimum <5 ppb @ 25km. MkIV CO minimum 12 ppb @ 22km

MLS HNO_3 agrees well, but is less sharply peaked as that of MkIV (possibly vertical resolution difference?).

HCN agreement is poor (real variability?). An improved MLS HCN product is currently under development (Pumphrey).

Other experimental MLS products (e.g. HOCl, CH_3CN) have been compared to MkIV profiles, and have been shown elsewhere.